

Coupled CFD-Thermal Analysis of Erosion Patterns Resulting from Nozzle Wedgeouts on the SRTMV-N2

The objective of this analysis was to study the effects of the erosion patterns from the introduction of nozzle flaws machined into the nozzle of the SRTMV-N2 (Solid Rocket Test Motor V Nozzle 2). The SRTMV-N2 motor was a single segment static subscale solid rocket motor used to further develop the RSRMV (Redesigned Solid Rocket Motor V Segment). Two flaws or “wedgeouts” were placed in the nozzle inlet parallel to the ply angles of that section to study erosion effects. One wedgeout was placed in the nose cap region and the other placed in the inlet ring on the opposite side of the bondline, separated 180 degrees circumferentially. A coupled CFD (Computational Fluid Analysis) –thermal iterative analytical approach was utilized at the wedgeouts to analyze the erosion profile during the burn time.

The iterative CFD-thermal approach was applied at five second intervals throughout the motor burn. The coupled fluid-thermal boundary conditions were derived from a steady-state CFD solution at the beginning of the interval. The derived heat fluxes were then applied along the surface and a transient thermal solution was developed to characterize the material response over the specified interval. Eroded profiles of each of the nozzle’s wedgeouts and the original contour were created at each of the specified intervals. The final iteration of the erosion profile showed that both wedgeouts were “washed out,” indicating that the erosion profile of the wedgeout had rejoined the original eroded contour, leaving no trace of the wedgeouts post-fire. This analytical assessment agreed with post-fire observations made of the SRTMV-N2 wedgeouts, which noted a smooth eroded contour.